

Claim Rejections Under 35 USC § 103

Claim 1¹ is rejected under 35 USC § 103(a) as being unpatentable over Taizo (JP 11-097493) in view of Ulmer (U.S. Patent No. 6,138,894) and Kuriyama (5,315,474). This rejection is traversed, and reconsideration and withdrawal thereof respectfully requested.

The following is a comparison of the claimed invention and the cited prior art.

An aspect of the invention, per claim 1, is a flip chip bonding method for mounting a semiconductor element on a wiring board comprising the steps of applying a vacuum to the semiconductor element through an ultrasonic bonding head to fixedly attach the semiconductor element to the ultrasonic bonding head. Pressure and heat are applied to solder bumps, formed on both or one of a connecting pad of the semiconductor element or a connecting pad of the wiring board for connecting the solder bumps under a state that the solder bumps are in contact, heated to a temperature more than the fusing point of the solder, and fused while the ultrasonic bonding head is moved in a plurality of directions or along a circular locus. The step of connecting the solder bumps is performed by a device, in which an inactive atmosphere or a reducing atmosphere is formed.

The Examiner asserts that Taizo substantially teaches the claimed process including applying a vacuum to a semiconductor element through an ultrasonic bonding head, applying pressure to gold bumps, and moving the ultrasonic bonding head in a plurality of directions. The Examiner relies on Ulmer to teach applying heat to solder bumps. The Examiner concludes that it would have been obvious to utilize a heater to heat the solder bumps to more than the fusing point in order to ensure the die is bonded to the substrate.

¹ The statement of the rejection recites claim 2 as being rejected. However, claim 2 was canceled, and the limitations of claim 2 added to claim 1. Therefore, it is apparent that the Examiner intended to reject claim 1.

The Examiner avers that Kuriyama teaches an inactive or reducing atmosphere during bonding. The Examiner concludes it would have been obvious to use a particular gas in order to prevent oxidation of the bonding surfaces.

The proposed combination of Taizo, Ulmer, and Kuriyama, does not, however, suggest the claimed invention. It would not have been obvious to combine Kuriyama with Taizo and Ulmer to achieve the claimed method. Kuriyama is directed to connecting fuse wires, not flip chip bonding, as required by claim 1. Furthermore, Kuriyama uses a torch 18 to melt the fuse wires 4. A torch is not used in the methods of Ulmer or Taizo. One of ordinary skill in this art would not have looked to the Kuriyama method of melting fuse wires with a torch to improve a process of flip-chip bonding, as taught by Taizo and Ulmer.

Although the Examiner acknowledges that Kuriyama deals with fusing wires, not flip chip bonding, the Examiner avers that Kuriyama, Ulmer, and Taizo all deal with semiconductor manufacturing, and in particular, with techniques to ultrasonically bond leads to pads. In view of Kuriyama's teaching of using a particular gas to prevent oxidation of bonding surfaces during ultrasonic bonding, the Examiner finds an expectation that Kuriyama's method would have a same or similar utility in the instant invention. Contrary to the Examiner's assertions, Applicant maintains that one of ordinary of skill in this art, considering the Kuriyama reference as a whole, would not have been motivated to incorporate the inactive or reducing atmosphere of Kuriyama in the Taizo and Ulmer methods because of the fundamental differences in the Kuriyama, and Taizo and Ulmer methods, as described above.

Claim 3 is rejected under 35 USC § 103(a) as being unpatentable over Taizo in view of Ulmer and Uno (JP 6-29357).

This rejection is traversed, and reconsideration and withdrawal thereof respectfully requested. The following is a comparison of the claimed invention and the cited prior art.

A distinguishing feature of the method of claim 3 is that the ultrasonic bonding head is moved along a circular locus while the solder bumps are fused.

The Examiner asserts that Uno teaches ultrasonic bonding by moving the bonding head along a circular locus.

Taizo, Ulmer, and Uno, whether taken alone, or in combination, do not suggest the claimed method. Taizo and Ulmer do not suggest moving an ultrasonic bonding head along a circular locus while the solder bumps are fused, as required by claim 3. It would not have been obvious to combine the apparent circular motion of the bonding head of Uno in the methods of Taizo and Ulmer because Uno does not teach flip chip bonding, as taught by Taizo and Ulmer. One of ordinary skill in this art would not have looked towards Uno to improve a process of flip chip bonding.

The Examiner avers that because the bump of Taizo was deformed in an approximate circle, the vibrations must have occurred within the locus of circle. Applicant notes that claim 3 requires that "the ultrasonic bonding head is moved **along a circular locus**." Claim 3 does not require that the ultrasonic bonding head is moved **within the locus of a circle**, as asserted by the Examiner. Figure 1d illustrates the motion of the ultrasonic bonding head along a circular locus. The motion along a circular locus, as claimed, is clearly different from the horizontal and vertical zig-zag motions taught by Taizo.

The instant claims are not suggested by any combination of Taizo, Ulmer, Kuriyama, and Uno. Obviousness can only be established by combining or modifying

the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either explicitly or implicitly in the references themselves or in the knowledge readily available to one of ordinary skill in the art. *In re Kotzab*, 217 F.3d 1365, 1370 55 USPQ2d 1313, 1317 (Fed. Cir. 2000); *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992); *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988). There is no suggestion in Kuriyama to provide an inactive or reducing atmosphere in a flip chip bonding method, as required by claim 1. There is no suggestion in Uno to move the ultrasonic bonding head along a circular locus, in a flip chip bonding method, as required by claim 3. The mere fact that references can be modified does not render the resulting combination obvious unless the prior art also suggests the desirability the modification. *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990). None of the cited references suggest the desirability of using an inactive or reducing atmosphere, or moving a bonding head along a circular locus in a flip chip bonding method.

The cited prior art does not suggest the beneficial migration of the oxide layer to the inside of the solder bumps without the use of solder flux by heating the solder bumps to more than the fusing point of the solder bumps and moving the ultrasonic bonding head in a plurality of directions or along a circular locus.

The only teaching of a flip chip bonding method including heating the solder bumps to more than the fusing point of the solder bumps and moving the ultrasonic bonding head in a plurality of directions or along a circular locus in an inactive or reducing atmosphere, is found in Applicants' disclosure. However, the teaching or suggestion to make a claimed combination and the reasonable expectation of success must both be found in the prior art,

and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

In light of the remarks above, this application is in condition for allowance, and the case should be passed to issue. If there are any questions regarding this Amendment or the application in general, a telephone call to the undersigned would be appreciated to expedite the prosecution of the application.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

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